ILLUSTRATED PREOPERATIVE
AND
POSTOPERATIVE CARE

Illustrated Preoperative and Postoperative Care

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TO MY CHIEF
WARREN H COLE

Preface

Preoperative and postoperative care has assumed its proper place of importance in the past decade Current writings deal almost universally with electrolytes and water balance One wonders if this has not been overemphasized at the expense of the equally important practical aspects Much of our present knowledge on electrolytes and water balance is still debatable and theoretical The material contained in this monograph has been taken from my lecture notes on the subject An attempt has been made to present it in a practical manner and to avoid the numerous and nebulous theories which have no place in a presentation of this type One must be as conversant with milliequivalents as with grains and grams Both of these systems have been utilized in this work

There is a trend to relegate bedside medicine to the laboratory This last statement should not be misunderstood I am cognizant of the fact that the laboratory may reveal the only contributory data in a given case however this is the exception and not the rule I utilize every bit of laboratory data available *when indicated* It is unnecessary to require *routine* liver kidney and/or electrolyte profiles to mention only a few on *every* patient The guides which determine the necessary laboratory tests are still the time honored ones namely a carefully elicited history and a well conducted physical examination The seasoned clinician is aware of this he practices medicine as an art as well as a science

In recent years much has been written about the need for delaying emergency operations in an attempt to put the patient in better

shape' Although commendable this may be carried to an impractical and dangerous extreme It must be remembered that it is possible to study the patient to death and to prepare him to death medically Surgical emergencies will always exist, and the sooner these are treated the better

The beautiful and lucid illustrations of Mr Carl Linden make for clearer understanding of the text and for easier retention of the material

A bibliography has been omitted intentionally To be adequate the number of pages would have exceeded the text

I wish to thank the J B Lippincott Company for their sincere and sympathetic co operation in aiding me in the completion of this work

PHILIP THOREK, M D

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SECTION ONE

PREOPERATIVE CARE

1

Evaluation

Preoperative care starts when the patient first consults the surgeon It is at this time that a sympathetic relationship should be established Such rapport must continue until the patient is restored to health The evaluation of a patient is 3 fold

1 Psychogenic
2 Nutritional
3 General

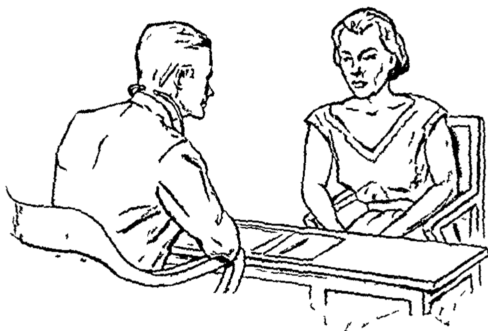


Fig 1 As the physician studies the patient so does the patient study the physician

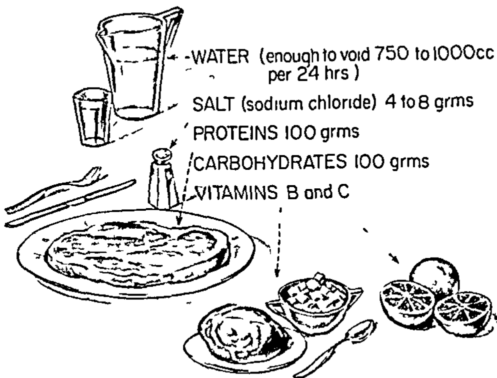


Fig 3 The daily nutritional requirements of the average nondepleted patient

NUTRITIONAL FACTORS

Malnutrition should be corrected preoperatively The patient requires 6 essential nutritional substances

1 Water
2 Electrolytes
3 Carbohydrates
4 Proteins
5 Vitamins
6 Fats?

Of these 6 elements only fat may be listed as immediately non essential The routine requirements of each of these substances are mentioned here briefly (Fig 3) They will be discussed in detail under postoperative care

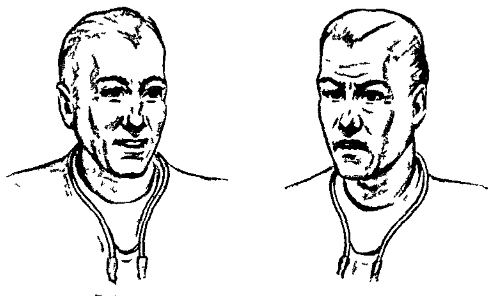


FIG 2 The surgeon s face should be confident not catastrophic

PSYCHOGENIC FACTORS

It is axiomatic that the patient who has implicit faith in his surgeon and whose mind is at rest will convalesce in a shorter period of time Let us not forget that as the physician studies his patient the patient is studying his physician (Fig 1) We must not transmit our fears and thoughts of complications to the patient By a mere facial expression the doctor can convey his interest and instill confidence A serious macabre expression on the face of the surgeon does much to instill fear and uncertainty in the mind of the patient (Fig 2) Exactly how much should we tell the patient and/or his relatives? This question cannot be answered unequivocally in every case There are personal equations which must be evaluated In many instances the *family physician* is better equipped to answer this question He too should advise the specialist who may be contacting the family for the first time

CARBOHYDRATES

The average adult at rest requires 25 calories per kilogram of body weight or 1 600 calories per day More is required during pathologic conditions, in infancy and in childhood A daily mini mum of 100 Gm of carbohydrate will usually suffice and avoid ketosis

PROTEINS

For daily maintenance the average surgical patient can be balanced on 100 Gm of protein per day

VITAMINS

The daily requirements are usually 1 500 mg of cevitamic acid and 2 ampules of vitamin B complex

GENERAL INVESTIGATION

Every patient who is about to undergo a major surgical procedure is entitled to a careful evaluation This includes a detailed history a thorough physical examination and certain *essential* lab oratory studies The ability to select only the necessary laboratory tests is a measure of the surgeon s skill The routine demand for so called liver kidney and electrolyte profiles as well as other tests too numerous to mention is to be deprecated It is unnecessary to study the patient to death

ESSENTIAL LABORATORY DATA (SPECIAL TESTS)

The so called *routine* laboratory procedures should include

1 Urinalysis
2 Essential blood tests
3 Roentgenogram of the chest
4 Electrocardiograms

If these tests indicate the need for further study then additional laboratory data can and should be obtained

Water

The average adult weighing approximately 154 lbs (70 Kg) will require 17 cc of water per pound of body weight or about 2 500 cc daily (Fig 4) This provides for replacement due to insensible losses and the excretion of urine It must be recalled that in children, particularly infants, the required amount per unit of body weight is about 3 times that of adults

Electrolytes

These include mainly sodium chloride potassium and bicar bonate As long as there are no abnormal losses (nasogastric siphon age, fistulas etc) the daily needs of the average adult may be met by 35 mEq each of sodium chloride, potassium and phosphate (For the detailed discussion of the postoperative management of these electrolytes see pp 32 41)

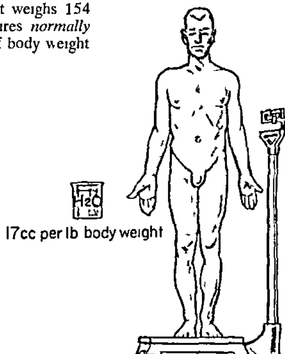


Fig 4 The average adult weighs 154 pounds (70 Kg) He requires *normally* 17 cc of water per pound of body weight or about 2,500 cc daily

BLOOD FORMED ELEMENTS
Normal ranges

	Birth	1 yr	5 yr	12 yr	Women	Men
Hematocrit %Vol of packed RBC/100 ml	43 63	32 40	36-44	39-47	39 47	44-52
Hemoglobin-Gm/100 ml	14 20	11 12 5	12-14 7	13 4 15.8	13 16	15 18
RBC-million/cu mm	4 1 5 7	3 9 4 7	4 0-4 8	4 3-5 1	4 2 5 0	4 8-6 0

FIG 6 Normal blood ranges

PLASMA CHEMICAL CONSTITUENTS

Plasma Na^+ -	137-147 mEq/L
Plasma K^+	4 0-5 6 mEq/L
Plasma Ca^{++}	4 5-5 8 mEq/L
Plasma Cl^- -	98-106 mEq/L
Plasma Protein	6-8 Gm/100 ml
Plasma HCO_3^- -	Adults 25-29 mEq/L
	Children 20 25 mEq/L

FIG 7 Normal plasma readings

be included If these tests reveal abnormalities then further investigation of the blood should be carried out In spite of normal erythrocytes and hemoglobin determinations the chronically ill patient may be severely anemic in terms of his total circulating hemoglobin or red cell mass A simple bedside test which gives an excellent clue to such a deficiency can be conducted in the following way the patient dangles his arm at his side, the veins on the dorsum of the hand do not distend if the blood volume is diminished (Fig 5) If the veins do not distend a more thorough investigation of the blood must be conducted Normal blood and plasma findings are represented in Figures 6 and 7

The two simplest and most accurate bedside tests for determining the *risk* of a patient are the diastolic blood pressure and the cough test

Urinalysis

The urine should be examined for the presence of sugar albumin and/or acetone A microscopic examination is made of the sediment If there is a departure from the normal, then one may determine the blood sugar and/or the degree of renal damage It is always better to obtain a catheterized specimen from females because of the possibility of contamination from a vaginal discharge or the presence of menstrual blood

Blood

This includes the determination of the hematocrit hemoglobin red cell count white cell count examination of the blood smear and bleeding and coagulation time

The hematocrit reading (percentage of packed cells) of the peripheral blood is one of the most important methods of detecting anemia It is more accurate than either the hemoglobin determination or the red blood cell count A serologic test for syphilis should

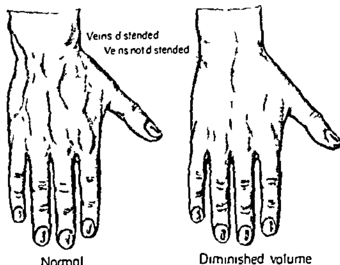


FIG 5 A simple test and excellent clue to determine the presence of diminished blood volume

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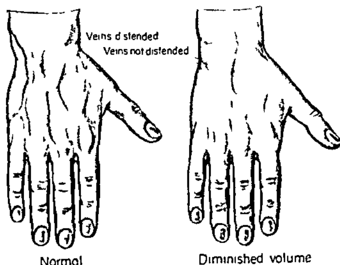


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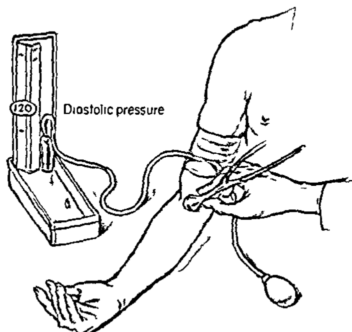


Fig 8 If the diastolic blood pressure is above 120 mm of mercury the patient has severe vascular damage and must be considered a poor surgical risk

Blood Pressure

If the *diastolic pressure* is above 120 mm of mercury the patient must be considered an extremely poor risk (Fig 8) Such a reading suggests an impending uremia and renal collapse In the event of a surgical emergency or in the presence of a malignant neoplasm an elevated blood pressure should not prevent surgery It should

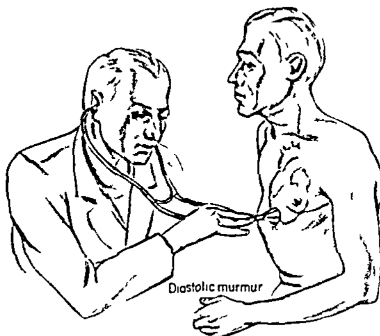


FIG 9 Diastolic murmurs are frequently more dangerous than systolic These patients should have the benefit of a cardiac consultant

be made clear to the patient s family that the patient is a poor surgical risk but that the surgery is imperative A diastolic heart murmur is usually more dangerous than a systolic (Fig 9) It behooves every physician specialist or otherwise to check the blood pressure and auscultate the heart of every surgical patient If these indicate possible trouble then consultation should be sought

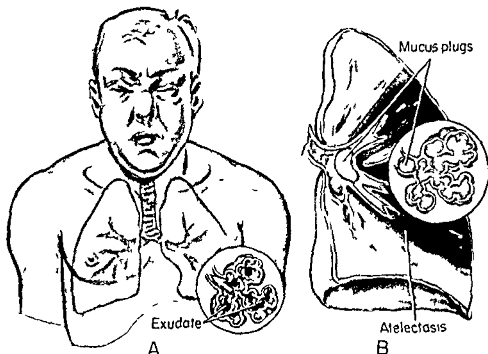


FIG 10 The cough test (A) If a patient s cough produces a wet and rattling sound the test is positive This indicates a tracheo bronchitis (B) If these numerous mucus plugs are not coughed up, atelectasis results

The Cough Test

The *cough test* is the simplest and possibly one of the most in formative in ascertaining the presence or the absence of tracheo bronchitis (Fig 10) This is conducted by asking the patient to cough If the resulting cough rattles and sounds wet, the test is

considered as positive and indicates a tracheobronchitis It is not the author s purpose to condemn or condone smoking, however, it is clearly evident that those patients with a positive cough test are generally smokers As long as the individual can cough up mucus, he can keep his bronchial tree open and aerate his lungs Surgery brings many factors into play which hinder coughing and encourages plugging of the bronchi Morphine, pain dehydration and inspissation of mucus plugs all tend to produce bronchial obstruction and atelectasis

Current trends in *preoperative medication* stress the greater usage of scopolamine in some cases rather than atropine Scopolamine has the same drying effect as atropine and acts as a synergist with morphine thereby necessitating a smaller dosage of the latter

Some top flight anesthetists believe that the administration of 10 mg of morphine and 1/100 gr of scopolamine produces a state of amnesia and an I don't care attitude which is particularly desirable in apprehensive patients Others feel that narcotics are unnecessary preoperatively because the elective patient has no pain We must recall that the morphine addict does not crave morphine to relieve pain but rather to give him a sense of well being and relieve him from the cares and the problems of daily life Barbiturates can be used in place of narcotics but the sedation produced in *hypnotic* doses does not relieve apprehension completely Some prefer intravenous barbiturates Narcotics in poor risk patients may produce objectionable circulatory changes hypotension appears more frequently with the tranquilizing drugs than with the narcotics Although there are preoperative routines each case presents a problem of its own and should be considered in that light

USES AND ABUSES OF NASOGASTRIC SIPHONAGE

Suction should be used only when indicated *Preoperatively*, suction must be used in cases of small bowel obstructions and in cases of gastric distention When one contemplates doing a splenectomy it becomes mandatory to institute gastric suction because it is almost impossible to mobilize the spleen in the presence of gastric distention The author has found it unnecessary to institute suction

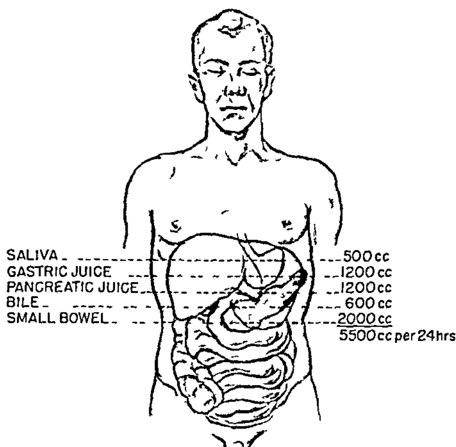


FIG 11 Nasogastric siphonage can deplete the patient of large amounts of necessary water and electrolytes The patient manufactures *5 500 cc of vital fluids and electrolytes every 24 hours* Whenever possible these should be left undisturbed

routinely in cases of cholecystectomy appendectomy, or herniorrhaphy When suction is instituted it depletes the patient of important electrolytes and water (Fig 11)

PREPARATION OF THE LARGE BOWEL

The era of exhaustive and exhausting preoperative purgation is fortunately over Such bowel cleansing dehydrates the patient and increases his postoperative distention A small tap water enema will usually suffice in the routine elective surgical case, in many instances even this could be abandoned Large bowel surgery requires more intensive preparation Most surgeons prepare the bowel with one of the newer antimicrobials (see p 59)

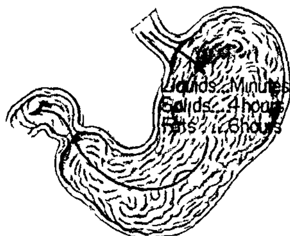


FIG 12 Do not dehydrate the patient preoperatively Solids leave the normal stomach in 2 to 4 hours fats inhibit peri stalsis and leave the stomach in 6 hours A glass of water leaves the stomach in a few minutes

PREOPERATIVE DIET

The preoperative diet should be simple It requires from 4 to 6 hours for a normal stomach to empty itself of a full meal fats remain in the stomach even longer A preoperative diet should be light nonfatty and low residue The average nonobstructed patient can partake of solid foods to within 6 hours of the operation Liquids leave the normal stomach rapidly a glass of water will pass through the pylorus in a matter of minutes Therefore it is illogical to deplete the patient of much needed fluids by adhering to the time honored routine of *nothing* by mouth after midnight' Such pa tients are subjected to many hours of unnecessary dehydration Patients can partake of small amounts of water to within 4 hours of surgery (Fig 12)

CATHETERIZATION

Preoperative catheterization is necessary only if the patient is unable to void or if pelvic surgery is contemplated In children the bladder normally is situated above the symphysis and may be injured in lower abdominal operations Catheterization should be routine in such cases In pelvic surgery a retention catheter should be used routinely (For postoperative catheterization see p 75)

PULMONARY INFECTIONS

Pulmonary infections may be treated by inhalation therapy in the form of Aerosol Smoking should be diminished or, preferably abolished preoperatively whenever possible This suggestion is much easier made than enforced

SO CALLED FOCI OF INFECTION

If there is an *obvious* focus, it should be eradicated However patients who are acutely ill or in need of surgery for malignant neoplasms cannot be put off because of poor oral or dental hygiene Loose teeth are a particular hazard when a general anesthetic is contemplated because of the possibility of aspirating the tooth, such teeth should be removed before surgery

SECTION TWO

POSTOPERATIVE CARE

2

The Immediate Postoperative Period

Postoperative care starts when the last stitch has been placed and the dressing applied

Since the advent of the recovery room postoperative care has improved immensely Nevertheless a dangerous period exists be tween the end of the operation and the trip to the recovery room The surgeon frequently leaves the operating room, and the anes thetist may be left alone It is during this 'let down period when the operation is over that accidents possibly fatal can occur Such accidents result from ill timed removal of an endotracheal tube arterial hypotension replacement of high oxygen intake with room air, respiratory depression from muscle relaxants vomiting and/or pain and restlessness

REMOVAL OF THE ENDOTRACHEAL TUBE

If such a tube is removed during a light plane of anesthesia, laryngospasm and closure of the glottis may result Hypoxia can occur rapidly particularly in infants and children This can be avoided if the extubation is done gently during a deeper plane of anesthesia or when the patient is awake When laryngospasm de velops forceful attempts to inflate the lungs usually results in inflation of the stomach and elevation of the diaphragm Intravenous succinylcholine chloride may relax the larynx and permit gentle pressure on the breathing bag to supply the necessary oxygen

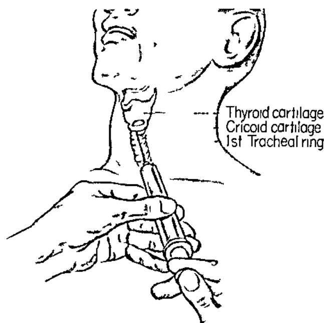


FIG 13 An emergency method of supplying oxygen in cases of severe laryngospasm

Should this fail it becomes necessary to insert a large bore needle into the trachea below the cricoid cartilage and inject air through a syringe or oxygen through a tube (Fig 13)

ARTERIAL HYPOTENSION

This condition may advance to a seriously low level before it is detected Following any change in position, particularly involving the inferior extremities the anesthetist should check the blood pressure Such hypotension may be produced by the jarring motions of an elevator rough handling in transferring the patient from the operating table to the litter and/or from the litter to the bed

RESPIRATORY COMPLICATIONS

Atelectasis may be masked by the inhalation of a high concentration of oxygen because the hypoxia is not visible At the end of an operation when room air is inhaled the atelectatic effects become evident Unrecognized hypoxia must be kept in mind constantly, since cyanosis may be absent Pulmonary ventilation and proper oxygenation must be established before the patient leaves the operating table Fewer airway obstructions will be encountered if the postoperative patient is transported in the lateral rather than the supine position This is easier said than done for it requires trained personnel and proper equipment

VOMITING

Any anesthetized patient may vomit, in fact vomiting at the conclusion of an operation eliminates retained material which otherwise might cause nausea and retching Such vomiting is harmless as long as the contents are not aspirated To avoid such difficulties the patient s head should be turned to one side and a well functioning suction apparatus used properly Excessive pharyngeal stimulation with a suction catheter may do more harm than good Some believe that when gastric contents have been aspirated the treatment of choice is irrigation with 10 to 20 cc of sterile saline through an endotracheal tube The removal of particulate matter requires bronchoscopic aspiration

PAIN AND RESTLESSNESS

Immediate postoperative restlessness and pain may progress to actual delirium which requires immediate and energetic therapy Intravenous narcotics or tranquilizers should be used but in smaller doses than are usually required because they may cause hypotension retching and vomiting

3

The Recovery Room

Many of the smaller hospitals are now equipped with or are installing recovery rooms (Fig 14) These should be placed adjacent to or on the same floor as the operating room The

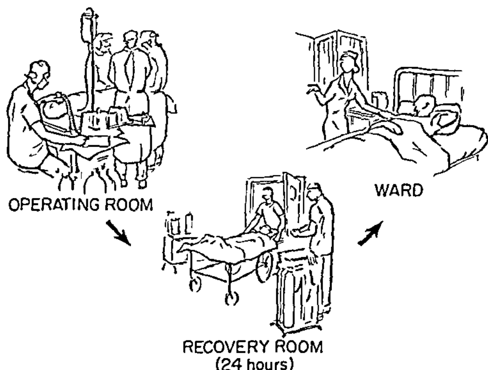


FIG 14 The well-equipped recovery room is an essential part of adequate postoperative care

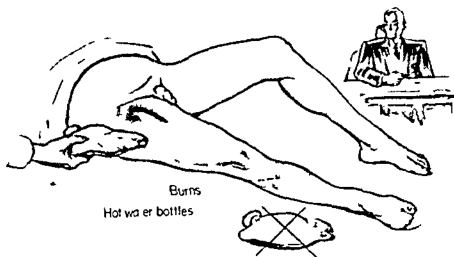


Fig 15 Never use hot water bottles on the anesthetized patient or the patient in shock This may cause burns and result in malpractice suits

recovery period is frequently a critical one especially after pro longed and extensive surgical procedures Any surgical patient is subject to respiratory and circulatory complications and such eventualities necessitate immediate and energetic corrective therapy The patient should remain in recovery for the first 24 hours This room should be properly staffed and equipped with the arma mentarium necesary to meet any postoperative emergency Many excellent articles and books have been written on this subject The *postoperative bed* is not too inconsequential to mention Hot water bottles never should be placed against an anesthetiezd patient or a patient in shock (Fig 15) Too many medicolegal suits have re sulted from the injudicious use of such heating agents which can result in serious burns There may be exceptions to the rule but hot water bottles have been forbidden on the author s service If external heat is needed it can be attained safely by means of warm bedding and preheated blankets

4

Parenteral Fluids

The body maintains an amazingly constant internal environment this is known as *homeostasis* To stabilize such uniformity of the fluid matrix of the body, the patient must be supplied with proper amounts of water, electrolytes and proteins Marine organisms require a specific salty environment (sea water) to carry on their numerous complex vital chemical processes The chemical com position of the extracellular fluid of man is practically the same as its sea water prototype In other words man s oceanic environment is now internal instead of external Numerous works have been written on this subject however some disagreement exists as to the type of solution and the exact amount of water and electrolytes necessary for the maintenance of homeostasis Some of the more commonly used solutions are shown in Figure 16 Every post

	PLASMA (NORMAL)	SALINE ISOTONIC (0.9%)	SALINE HYPERTONIC (5.0%)	RINGER'S SOLUTION	RINGER'S LACTATE (Hartmann's fluid)	DARROW'S LACTATE	Na LACTATE M/6 (1.9%)
Na^+	142	154	850	147	130	122	167
K	5			4	4	35	
Ca	5			6	4		
Mg	2						
Cl	103	154	850	157	1 1	104	
Lactic	5				27	53	167
PO_4	2						

FIG 16 Some of the more commonly used replacement solutions

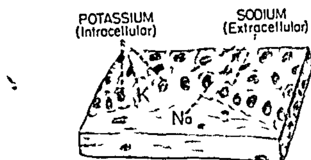


Fig 17 Most of body potassium is intracellular and most of body sodium is extracellular

operative patient must be supplied with adequate amounts of water, salt, proteins, carbohydrates and vitamins Fats are still under investigation but should be available soon in a form safe for parenteral administration Fats are rarely essential in the immediate postoperative care of the patient Osmotic pressure of intracellular and extracellular body fluids is maintained by the shift of water and electrolytes across cell membranes The chief cation of intracellular fluids is potassium that of extracellular fluid is sodium (Fig 17) The kidneys play an all important role in maintaining fluids and electrolytes at constant levels

WATER

This substance makes up about 70 per cent of the total body weight in the average normal adult About 80 per cent of the body fluid is found in the cells, and the rest is extracellular (interstitial spaces and blood vessels) (Fig 18) In obese patients the total body water may be less than 40 per cent hence such individuals do not tolerate fluid imbalance well It is important to have a simple method of determining the patient s water needs and water balance Usually this can be determined easily and quite accurately by utilizing the rule that the average patient must be given enough

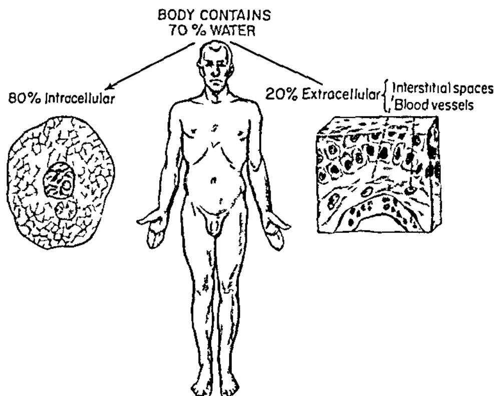


FIG 18 In the average adult water makes up 70 per cent of the total body weight 80 per cent of this is intracellular and 20 per cent is extracellular (interstitial spaces and blood vessels)

water to permit him to urinate between 750 and 1 000 cc per day Some authorities prefer to calculate the water and electrolyte needs by determining the number of milliliters necessary per meter of body surface Body surface area determinations are made from the so called nomogram using height and weight Numerous factors, such as excessive perspiration diarrhea respiratory rate drains fistulas and nasogastric siphonage alter the urinary output and water needs, these require individual correction

It has been stated that the daily amount of water ingested in food

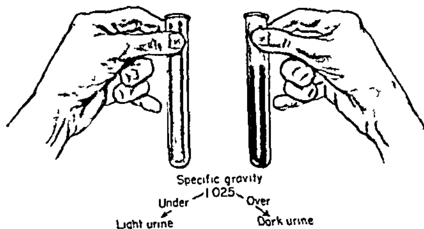
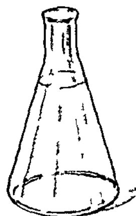
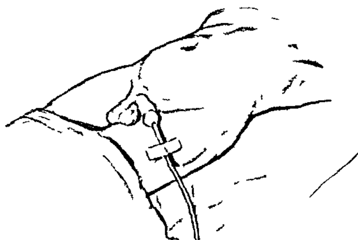


Fig 19 If the patient is properly hydrated the urine is light in color and the specific gravity is below 1 025 If dehydration is present the urine is darker, and the specific gravity is above 1 025

is approximately 1,500 cc An additional 5 500 cc of water or potential water enters the esophagogastric intestinal tract per 24 hours as saliva 500 cc, gastric juice 1 200 cc bile 600 cc pancreatic juice 1 200 cc and succus entericus 2 000 cc (Fig 11) This constitutes a total of 8 000 cc which is 11 per cent of the body weight and over half of the extracellular water Not all of this is present in the gastro intestinal tract at a given time Water absorption most likely begins in the upper small bowel and continues to and through the right half of the colon normally only 200 cc is excreted in the feces It is dangerous to state unequivocally that every postoperative patient must have 3 quarts of fluid per day or continuous intravenous drip The average patient will urinate approximately 750 cc of urine daily if 2 000 cc of water is supplied These rules do not pertain to the nephritic or the cardiac patient If the physician wishes to determine *rapidly* the state of hydration of a given patient he may test the specific gravity of the urine (Fig 19) Another method is to catheterize the patient and





750 to 1000cc per 24hrs or 10 drops per minute

FIG 20 The properly hydrated patient will put out 10 drops of urine per minute or from 750 to 1 000 cc of urine per 24 hours

determine the amount of urine he puts out in 1 minute A properly hydrated patient will void 10 drops of urine *per minute* (Fig 20) Clinical signs of dehydration should be detected easily They are thirst dryness of the tongue sunken eyeballs and the loss of tissue turgor (Fig 21)

DEHYDRATION





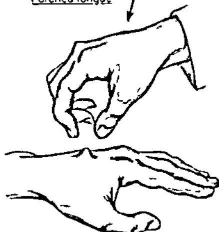




FIG 21 Clinical signs of dehydration

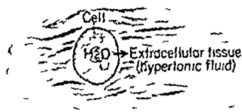


FIG 22 Primary water depletion Because of the hypertonicity of the extracellular fluid water moves out of the cell

PRIMARY WATER DEPLETION

In primary water depletion (esophageal obstruction coma etc) the extracellular fluid becomes hypertonic causing water to move from the cell to the extracellular space (Fig 22) Although the resulting intracellular dehydration may be marked there may be no change in plasma volume or electrolyte concentration There fore in this condition there is a small urinary output and normal or increased concentration of plasma protein and/or electrolytes The treatment of primary water loss consists of water replacement This is accomplished best by the administration of adequate amounts of 5 per cent dextrose in water Since relatively small amounts of salt have been lost hypotonic saline or amino acid solutions containing a little sodium chloride are the ones of choice The average post operative patient requires 1 liter of water to replace insensible loss (breathing and sweating) plus 1 liter for urinary output Approxi mately 4 Gm (69 mEq) of sodium chloride will usually replace the daily salt Less salt and water are required the first 24 post operative hours because of the stress response to surgery (see p 60)

SODIUM CHLORIDE

Sodium chloride (salt) requirements of the average individual range between 4 and 12 Gm (69 to 208 mEq) daily Such require ments are altered by weather heat fever suction, vomiting and

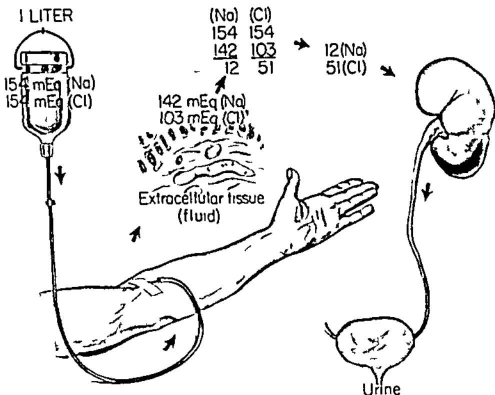


FIG 23 So-called physiologic saline This is an unphysiologic solution, since it has 154 mEq each of sodium and chloride per liter while extracellular fluid has 142 mEq of sodium and 103 mEq of chloride per liter Because of this imbalance whenever a liter of physiologic saline solution is given the kidney must excrete the 51 excess mEq of chloride and 12 excess mEq of sodium Normal kidneys can do this but impaired kidneys cannot

fistulas to mention only a few The terms normal saline' or physiologic solution of sodium chloride refer to a 0 9 per cent solution Such a solution is actually *unphysiologic* hence it should be referred to as an *isotonic* solution of sodium chloride

An isotonic solution of sodium chloride contains 154 mEq of sodium per liter (Fig 23) The sodium content of extracellular

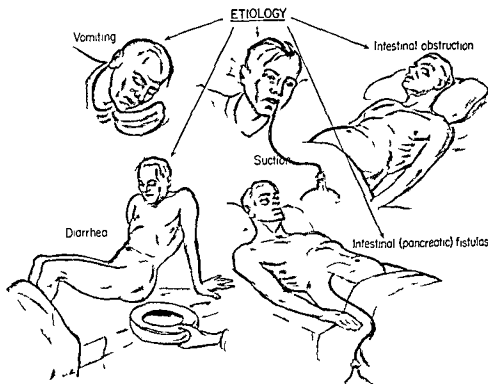


FIG 24 The more common causes of primary salt depletion

fluid is 142 mEq per liter Therefore the sodium content of an isotonic solution of sodium chloride is 12 mEq per liter greater than the sodium content of extracellular fluid Although this may not be the ideal relationship it is not harmful The *chloride* content of extracellular fluid is 103 mEq per liter as compared with 154 mEq of chloride per liter of isotonic sodium chloride This means an excess of 51 mEq of chloride per liter of isotonic solution Such a discrepancy places a load upon the kidneys which must maintain a constant electrolyte balance of the extracellular fluid These 51 mEq of excess chlorides and 12 mEq of excess sodium per liter must be excreted If the kidneys are impaired such a load (particularly the chloride) may become serious or even lethal Excesses of chloride may also disturb seriously the acid base equilibrium of the body There are 9 Gm of sodium chloride in each liter of

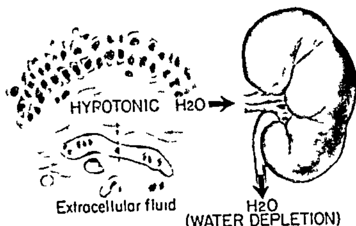


FIG 25 Primary salt depletion In this condition the extracellular fluid is hypotonic The kidneys attempt to combat this hypotonicity by excreting large amounts of urine (water) and little or no salt

isotonic salt solution The administration of 2 or 3 such liters daily places 18 or 27 Gm of salt respectively into the body, results in tissue edema dehiscence of suture lines delay of healing and/or possibly death However if a patient is in negative sodium balance then it may become necessary to administer more than 9 Gm It is at a time such as this that flame photometric readings and electrolyte determinations become necessary

PRIMARY SALT DEPLETION

Primary salt depletion is more common than primary water depletion The most common causes are vomiting gastric suction, intestinal obstruction, diarrhea and intestinal tract fistulas (Fig 24) In this condition the extracellular fluid becomes *hypotonic* The kidneys attempt to combat this hypotonicity by excreting large amounts of urine and no salt (Fig 25) the kidneys cannot retain water in the absence of salt hence further water depletion also occurs even if large amounts are supplied The plasma chloride concentration may remain normal until the kidneys can no longer

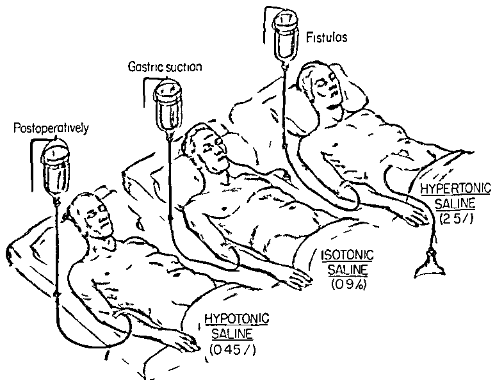


FIG 26 The type of salt solution necessary to correct primary salt loss depends upon the source of such losses Hence hypotonic isotonic and hypertonic solutions should be available and used as indicated

excrete the extracellular water Oliguria or anuria may precede the appearance of clinical shock In primary salt depletion the plasma reflects the changes in chloride or bicarbonate concentrations depending upon which body fluid is lost The loss of gastric juice produces a reduction of plasma chloride (normal 100 mEq) and an elevation of bicarbonate ion concentration (above 30 mEq) There may also be a small drop in plasma sodium These patients develop alkalosis (see p 44) When the loss is due to bile or pancreatic juice there is a greater loss of sodium bicarbonate than sodium chloride The plasma bicarbonate is reduced below 25 mEq and there might be a slight increase in plasma chloride These

patients develop acidosis (see p 44) The treatment for primary salt loss will vary according to the source of such loss In general however, one may follow this plan (Fig 26)

1 *Hypotonic* salt solutions (0 45%) should be used in the immediate postoperative period because of fluid and salt retention (Steroid Action, see p 61)

2 *Isotonic* solutions of sodium chloride (0 9%) as a general replacement should be used primarily when gastric juice is lost It must be recalled that gastric juice is often hypotonic hence replacement of such drainage contents by the volume for volume rule is not always accurate it requires re evaluation if such loss is prolonged

3 *Hypertonic* solutions of sodium chloride (2 to 5%) are preferred *in patients with pancreatic or intestinal* fistulas because of the great salt loss To attempt to compensate for such heavy salt losses with isotonic salt solutions would result in an excessive urinary output Continuous and daily re evaluation of these cases will determine the necessary requirements

POTASSIUM

This cation is chiefly intracellular The exact daily requirement is not known, however it has been estimated that the average adult requires from 2 to 4 grams (51 to 102 mEq) The primary causes of potassium *deficiency* include vomiting diarrhea pyloric obstruction ulcerative colitis intestinal fistulas prolonged administration of ACTH or cortisone and continued usage of potassium free solutions Overproduction of ACTH endogenously may result from diabetic acidosis Potassium deficit may also result from increased body utilization of potassium as occurs during the healing of burns Clinical findings of this deficit are characterized by a triad which includes *W*eakness *A*norexia and *S*ilent abdomen (Fig 27) which the author calls the W A S triad If cells are deprived of potassium they cannot function properly this refers particularly to muscle cells (gastro intestinal and cardiac) When a patient is in negative

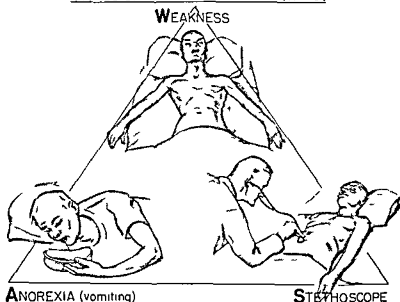


FIG 27 Potassium deficiency is characterized by a triad consisting of Weakness Anorexia and a Silent abdomen—the W A S triad

potassium balance the cells become depleted of this ion, sodium which exists mainly as an extracellular ion attempts to replace the lost potassium and becomes intracellular (Fig 28) Water follows the sodium into the cell with a resulting cellular edema Swollen cells cannot function properly this being particularly true of the mass of muscle cells Hence we find electrocardiographic changes and distended bowel (see p 39) Palpable muscles feel soft and

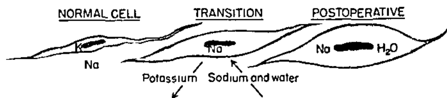
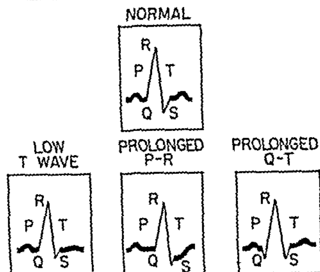


FIG 28 When potassium leaves the cell sodium and water replace it this results in cellular edema

FIG 29 Diagram of electrocardiographic findings in potassium deficiency



puttylike, and if the condition continues untreated, extreme weakness tremors and coma result Electrocardiographic findings of low voltage and flattening of the T waves are present when the potassium level is below 4 mEq (Fig 29) The plasma potassium may be normal or even increased in an *early* cellular potassium deficit

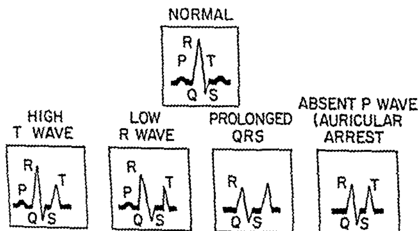


FIG 30 Diagram of electrocardiographic findings in potassium excess

KIDNEY RESPONSE TO Na and K LOSSES

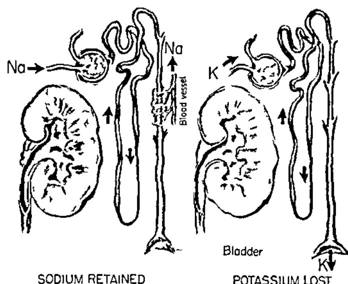


FIG 31 The normal kidney has the ability to reabsorb sodium for the purposes of conservation in cases of sodium loss Unfortunately, this function does not exist in cases of potassium loss The kidney does not reabsorb potassium and this cation continues to be lost

hence the plasma level does not always reflect the true cellular potassium status (Fig 30) If alkalosis persists after adequate sodium chloride therapy and hydration, one must suspect a potassium deficit

When sodium and potassium are being lost, the normal kidney conserves the sodium by almost total tubular reabsorption, the urine contains practically no sodium (Fig 31) Unfortunately, such a safety valve does not exist for the conservation of potassium Even in conditions of severe potassium deficit this cation continues to be lost in the urine

The *treatment* of potassium loss requires careful replacement Since excessive potassium may produce a heart block and sudden death it must be administered cautiously It is usually contra

indicated in cases of severe oliguria or anuria because of a potassium pile up In emergency treatment from 4 to 5 Gm of potassium chloride should be given in 1 liter of 5 per cent dextrose and water After this 3 Gm of parenteral potassium chloride is usually necessary to maintain daily requirements *Oral* administration of potassium chloride should be instituted as early as possible (5 to 10 Gm) daily for many days because the depletion is difficult to overcome The reason for this is that the homeostatic mechanism of the body attempts to prevent extracellular potassium from going above a level of 5 5 mEq per liter

PROTEIN REQUIREMENTS

The *protein requirements* for the average adult vary, depending upon the amount of physical energy expended but have been calculated as being approximately 100 Gm per day The protein needs of the desk worker are much less than those of the physical laborer However, at bedrest the average postoperative patient will not tear down his own proteins if we supply this minimum of 100 Gm per 24 hours If the patient cannot take this per mouth, it must be supplied parenterally in blood plasma or one of the more modern solutions (hydrolasates) which supply the amino acids The usage of blood is discussed on page 90

CARBOHYDRATE REQUIREMENTS

Carbohydrates also should be supplied in the amount of 100 Gm per day again this figure varies This is administered in the form of 5 per cent dextrose The diabetic patient must also have his proper daily allotment but this must be covered with insulin Such special cases should be managed by a physician well versed in diabetes

VITAMINS

Fat soluble *vitamins* A and D usually are stored in the body but the water soluble vitamins B and C are depleted rapidly and require

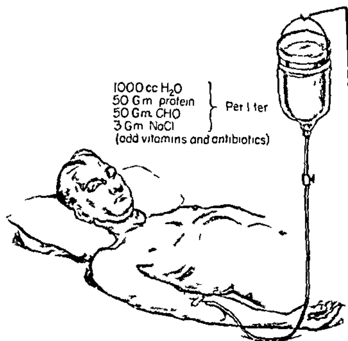


FIG 32 The average patient s daily needs are supplied in 2 liters of the solution depicted

replacement Vitamin B is necessary for the proper utilization of proteins hence it is advisable to give from 2 to 3 ampules of vitamin B complex per day Vitamin C has been aptly referred to as the surgeon s vitamin since it is essential for sound healing If this vitamin is deficient small peticheal hemorrhages occur and interfere with proper healing The author has found it advantageous to supply 1 500 mgm of cevitamic acid per day

Some pharmaceutical houses having become cognizant of these daily parenteral needs now manufacture solutions which meet them (Fig 32) Each 1 000 cc of such solution contains

1 1 000 cc of water
2 Approximately 3 Gm of sodium chloride
3 50 Gm of protein
4 50 Gm of carbohydrate

To these vitamins B and C and the necessary antimicrobials can be added Each liter of such solutions contains *half* of the daily requirements Therefore, it has been suggested that following the patient s morning care, a liter of such solution be administered at the *rate of one drop a second* This takes approximately 3 hours to give Then the patient may be relieved of further intravenous therapy until the evening, when the second liter is given In this way the patient receives his daily requirements of water 6 to 9 Gm of salt 100 Gm of protein 100 Gm of carbohydrates and the necessary vitamins and medicaments Let it be stressed again that in no instance should parenteral therapy be utilized if the patient can take fluid or food by mouth

Nothing by mouth is an order that may be carried to an extreme In cases of esophageal resection the order is necessary for 3 days, in gastric resections 2 days Following this the patient may have ice chips and sips of water (warm or cool) The next day tea dilute orange juice and fat free broth are added By the fifth to sixth day semisolids are given, and at the end of the first week the patient is on a liberal soft diet In patients not having anastomoses tea and water are permitted post nauseam Full liquids are given on the third day, and a regular light diet by the fifth to sixth day

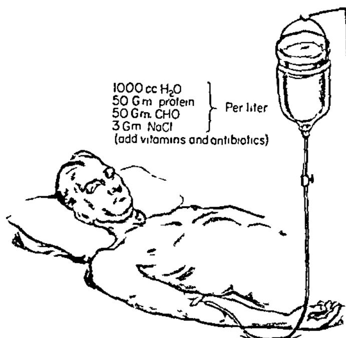


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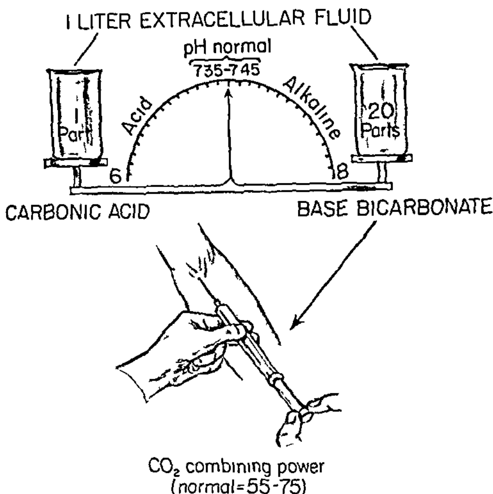


FIG 33 Normal acid base balance is in a pH range between 7 35 and 7 45 If the pH drops below 7 35 acidosis (acidemia) results, if the pH is above 7 45 alkalosis (alkalemia) is present In each liter of extracellular fluid there is approximately 1 part of carbonic acid to 20 parts of base bicarbonate

and the lungs Their compensatory functions will be discussed as we consider the various possibilities of acidosis and alkalosis

Acidosis and alkalosis may result from either metabolic (sys

5

Acidosis and Alkalosis

The understanding of acidosis and alkalosis requires a knowledge of the acid base balance in *extracellular fluid* This balance depends upon the relationship of carbonic acid to base bicarbonate It is a complex subject and difficult to present in a simplified way, this presentation may be criticised for oversimplification However such criticism must be accepted graciously since it is better to understand a little than to misunderstand a lot The degree of acidity or alkalinity of a fluid is determined by the hydrogen ion concentrations which are expressed in terms of the pH The pH increases as the alkalinity increases and it decreases as the acidity increases If an individual is in acid base balance his pH will be within the normal range of 7 35 to 7 45 (Fig 33) If the pH drops below 7 35 acidosis (acidemia) is present, if the pH rises above 7 45 alkalosis (alkalemia) is present Acidosis and alkalosis are symptom complexes which result from excesses or deficits of *carbonic acid or base bicarbonate The pH of water is approximately* 7 hence if one considers water neutral, then the normal pH of extracellular fluid is alkaline In each liter of extracellular fluid there exists normally 1 33 mEq of carbonic acid and 27 mEq of base bicarbonate For convenience s sake we may say that the ratio is 1 part of carbonic acid to 20 parts of base bicarbonate The normal pH 7 35 to 7 45 will be maintained as long as this ratio of 1 to 20 is maintained Base bicarbonate can be determined by *testing the CO_2 combining power (normal 55 to 70) This delicate* acid base balance is maintained mainly by two organs the kidneys

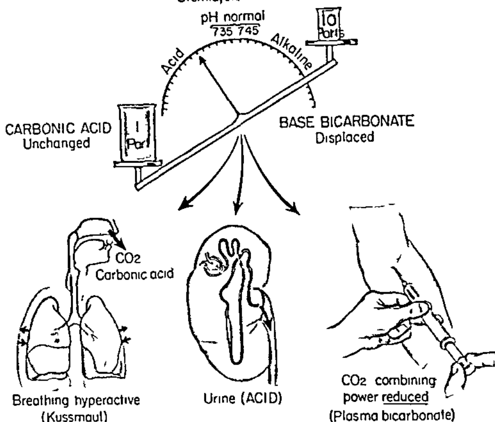


FIG 34 Metabolic acidosis (base bicarbonate deficit) In this condition chlorides organic acids and ketone bodies *displace* the base bicarbonate and the pH of the extracellular fluid drops below 7 35 The lungs attempt to compensate by means of hyperactive breathing thus blowing off excess carbonic acid (CO_2) The kidneys attempt to compensate by excreting hydrogen ions (acid) and conserving base bicarbonate The CO combining power is reduced Although this illustration shows the carbonic acid unchanged it may actually be lowered by hyperactive breathing

temic) causes or respiratory causes Four types of such disturbances will be considered separately They are

1 Metabolic acidosis
2 Metabolic alkalosis
3 Respiratory acidosis
4 Respiratory alkalosis

METABOLIC ACIDOSIS

This condition (base bicarbonate deficit) (Fig 34) is brought about by a displacement of base bicarbonates by acid or acidlike material Those substances which most frequently displace the base bicarbonate are chlorides organic acids which result from renal insufficiency (uremia), diabetes mellitus, ketogenic diets severe infectious disease, starvation and diarrhea particularly in infants Whenever ketone bodied, organic acids or chlorides replace bicar bonate ions the scales balance to the acid side as the pH of extra cellular fluid drops below 7 35 This type of acidosis is *not* due to an actual increase in acids but rather to a base bicarbonate displace ment The acid base ratio now changes from the normal to 1 to 20 to approximately 1 to 10 The body (kidneys and lungs) attempts to compensate in the following ways The lungs try to rid the body of carbonic acid by becoming hyperactive and ' blowing off carbon dioxide (carbonic acid) Clinically, this is manifested by an in creased deep p useless Kussmaul type of respiration which is characteristic of metabolic acidosis There are variations in the types of breathing depending upon the degree of acidosis In a mild acidotic condition only shortness of breath may be noted in moderate to severe cases breathing is of the Kussmaul type but in extreme cases the breathing may actually become hypoactive The *kidneys* attempt to compensate by excreting excessive amounts of hydrogen ions and conserving base bicarbonates Therefore the urine is distinctly *acid* The pH of the urine is usually below 6 0 but here again there can be exceptions The CO combining power will be *reduced* since the plasma bicarbonate reflects the level of the extracellular base bicarbonate It must be emphasized that the CO

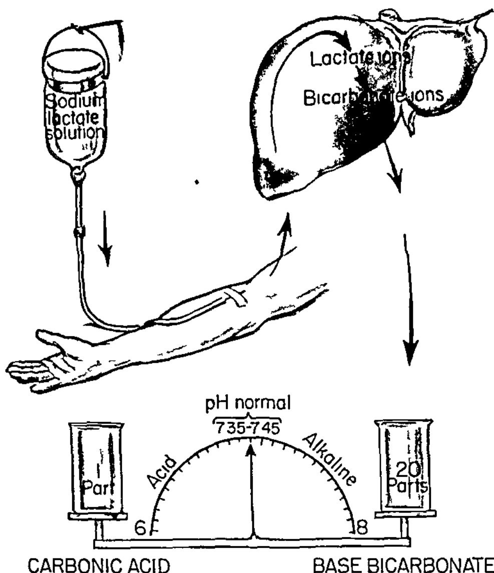


FIG 35 The treatment of metabolic acidosis Sodium lactate solutions should be given because the lactate ions are changed in the liver and replaced by bicarbonate ions The latter are necessary to correct the base bicarbonate deficit

combining power determination by itself *cannot* indicate whether acidosis or alkalosis is present (see Respiratory Acidosis p 53) Since there are no recognizable symptoms of mild acidosis, one must depend upon the laboratory to determine the presence of this condition Weakness, disorientation, stupor and coma will vary according to the severity of the case

The *treatment* of this condition is 2 fold First, the cause must be removed second, solutions containing *sodium lactate* should be given The lactate ions are metabolized by the liver and replaced by bicarbonate ions (Fig 35) Fluid volume deficits must be replaced and carbohydrate is of benefit as a rapid source of energy

Ringer s lactate is an excellent solution to use because it contains 27 mEq of lactate per liter For the severe cases of acidosis with extreme hyperpnea 6/Molar sodium lactate should be used However it should be recalled that lactate cannot be metabolized in the presence of poor liver function or congestion due to cardiac failure

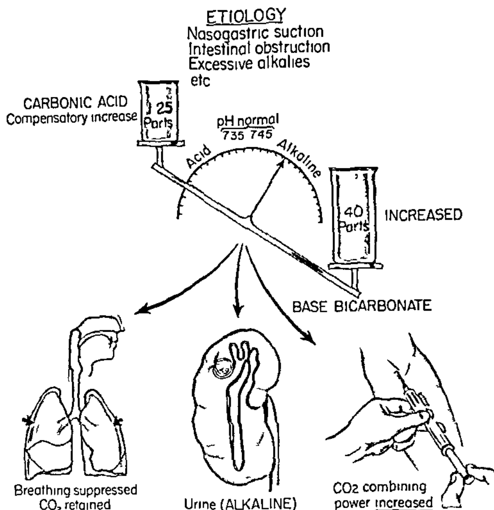


FIG 36 Metabolic alkalosis (base bicarbonate excess) In this condition the base bicarbonates are increased and the pH is increased The normal acid base ratio of 1 to 20 is now changed to 1 25 to 40 The lungs attempt to compensate by withholding carbonic acid (CO_2) hence the breathing is suppressed A compensatory increase in carbonic acid may result The kidneys attempt to compensate by retaining hydrogen ions and excreting bicarbonate ions the urine becomes alkaline The CO_2 combining power is increased

METABOLIC ALKALOSIS

This condition (base bicarbonate excess) is caused most frequently by a loss of chlorides and potassium through vomiting or prolonged usage of nasogastric siphonage (Fig 36) Other causes are pernicious vomiting of pregnancy, and those conditions which encourage potassium loss (roentgen therapy, hyperadrenalism excessive use of ACTH and overdosage with adrenal corticoids) An excessive intake of alkalies in the course of peptic ulcer treatment may also result in metabolic alkalosis A loss of chlorides (vomiting gastric intubation etc) results in a compensatory increase of base bicarbonate This is explained by the fact that as a result of the loss of chloride ions an excess of sodium (positive ions) becomes available to attach to bicarbonate radicals The bicarbonate becomes available as it leaves the red corpuscles, it has an affinity for free sodium and results in an increase in sodium bicarbonate

The pH now rises above 7 45 and an alkalosis (alkalemia) results death occurs when the pH is above 7 8 The body tries to compensate for a base bicarbonate excess by bringing its two main organs (lungs and kidneys) into play The lungs attempt to hold back carbon dioxide (carbonic acid) in an effort to increase the body acidity This will result in a diminished or a suppressive type of breathing and a compensatory increase in carbonic acid The kidneys will retain hydrogen ions and excrete bicarbonate ions resulting in an alkaline urine The CO combining power in metabolic alkalosis is increased One must not forget the so called *paradoxical urine* which appears rarely in instances of metabolic alkalosis where the urine is acid This is explained by the fact that the losses of excessive sodium in the urine distort the osmotic equilibrium and the kidneys attempt to conserve sodium Increased alkalinity in the extracellular fluid may decrease the ionization of calcium produce a calcium deficiency and result in tetany In some cases of severe metabolic alkalosis tetany and convulsions may be encountered In such instances the reflexes are found to be hyperactive and the muscles hypertonic

The *treatment* of base bicarbonate excess is based upon the

RESPIRATORY ACIDOSIS

This condition (carbonic acid excess) is brought about by a retention of carbon dioxide in the lungs (Fig 38) Such retention may be brought about by morphine poisoning, barbiturate poisoning paralysis of the bulbar portion of the medulla (poliomyelitis), or breathing gas which is excessively high in a concentration of carbon dioxide An excess of carbon dioxide plus water produces an excess of carbonic acid The pH of the extracellular tissue drops below 7 35, and acidosis (acidemia) results Death occurs when the pH gets below 6 8 The breathing becomes suppressed, the patient complains of marked weakness, and later disorientation and coma appear The lungs are unable to compensate The bulk of the compensatory process falls to the kidneys and they respond by excreting excess amounts of hydrogen ions while conserving base bicarbonates The urine becomes markedly acid (pH below 6 0) Such acidity can be determined readily by Nitrazine paper As a result of this renal conservation of base bicarbonate there is a compensatory rise in base bicarbonate which is determined by an increase in CO_2 combining power Therefore one should not be confused by the fact that although this is a form of acidosis the CO_2 combining power is increased It was noted that in metabolic acidosis the CO_2 combining power is decreased (see p 46)

The *treatment* is directed to removing the cause and the supplying of lactate solutions (Hartmann s modified or 6/Molar lactate) The lactate ions are metabolized in the liver and replaced by bicarbonate ions which compensate for the carbonic acid excess

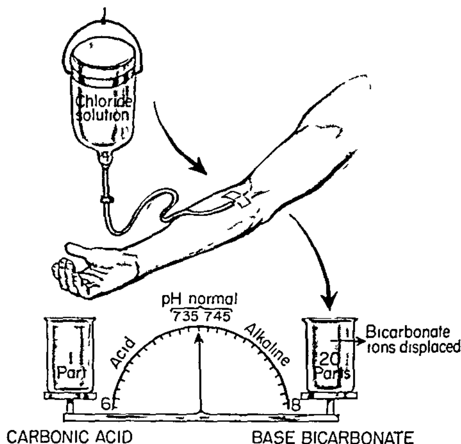


FIG 37 Treatment of metabolic alkalosis Chloride-containing solutions are administered because chloride ions replace bicarbonate ions and correct the base bicarbonate excess

supplying of chloride containing solutions, the chloride ions replace bicarbonate ions and relieve the base bicarbonate excess (Fig 37) Potassium deficit is almost always present in these cases and must be corrected The solution of choice is Ringer s solution since this has a moderate excess of chloride (10 mEq per liter) over sodium It also contains calcium and potassium When metabolic alkalosis is extremely severe ammonium chloride solutions have been administered at a slow rate (1 liter per 4 hours) This rate must be utilized because of the tendency of ammonium chloride to cause hemolysis

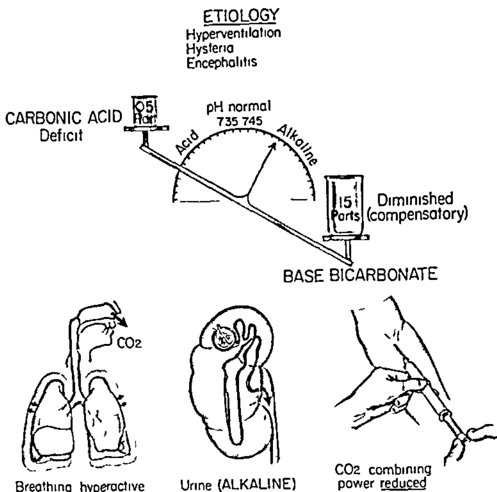
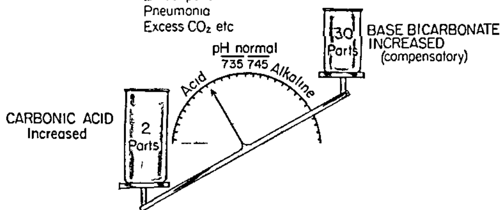
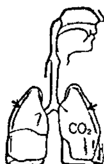


FIG 39 Respiratory alkalosis (carbonic acid deficit) This condition is associated with an excessive output of carbon dioxide (carbonic acid) The breathing is hyperactive The kidneys attempt to compensate by retaining hydrogen ions and the urine becomes alkaline As a result of this the base bicarbonate is diminished, and the carbon dioxide power is reduced

RESPIRATORY ALKALOSIS

This condition (carbonic acid deficit) results from an increased rate and depth of breathing hyperventilation (Fig 39) It is associated with such conditions as hysteria encephalitis oxygen want







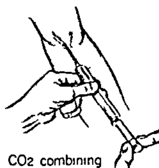
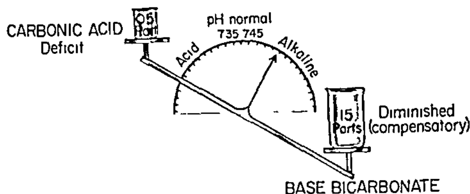
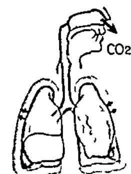


FIG 38 Respiratory acidosis (carbonic acid excess) Any interference with breathing or depression of the respiratory center may cause respiratory acidosis As a result of this, carbon dioxide (carbonic acid) is increased and the pH leans to the acid side Instead of 1 part of carbonic acid this pile up results in 2 parts of carbonic acid The kidneys attempt to compensate by retaining base bicarbonates (30 parts) and excreting hydrogen ions and nonbicarbonate anions The urine becomes strongly acid, and the CO_2 combining power becomes increased







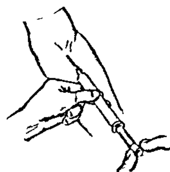


FIG 39 Respiratory alkalosis (carbonic acid deficit) This condition is associated with an excessive output of carbon dioxide (carbonic acid) The breathing is hyperactive The kidneys attempt to compensate by retaining hydrogen ions, and the urine becomes alkaline As a result of this the base bicarbonate is diminished and the carbon dioxide power is reduced

RESPIRATORY ALKALOSIS

This condition (carbonic acid deficit) results from an increased rate and depth of breathing hyperventilation (Fig 39) It is associated with such conditions as hysteria encephalitis, oxygen want

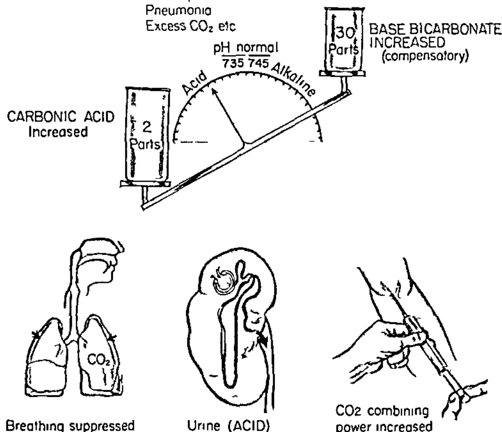


FIG 38 Respiratory acidosis (carbonic acid excess) Any interference with breathing or depression of the respiratory center may cause respiratory acidosis As a result of this carbon dioxide (carbonic acid) is increased and the pH leans to the acid side Instead of 1 part of carbonic acid this pile up results in 2 parts of carbonic acid The kidneys attempt to compensate by retaining base bicarbonates (30 parts) and excreting hydrogen ions and nonbicarbonate anions The urine becomes strongly acid and the CO_2 combining power becomes increased

6

Chemotherapy

This subject has become an exhaustive and exhausting one, it will be discussed here briefly

PYOGENIC BACTERIA

The *bacteria* of greatest importance in surgical infections are the so called *pyogenic* (pus forming) group This includes staphylo coccus, streptococcus, pneumococcus meningococcus and gonococ cus sometimes it is applied to the colon bacillus The tubercle bacillus although not considered as being pyogenic may produce a thick pus in the so called cold abscess

The *diagnosis* of the offending organism or organisms can be made in the following ways

1 Direct examination of the pus
2 Microscopic examination of a smear
3 Culture of the material
4 Sensitivity tests

Other methods include hanging drop technic agglutination and skin tests *Sensitivity* tests are particularly helpful in determining the antimicrobial of choice It is advisable to repeat these tests and cultures at weekly intervals when the infection is severe or pro longed because the bacteria can acquire resistance to a given drug or secondary (superimposed) infections may develop It is believed that bacteria can acquire resistance to all antibiotic agents except polymyxin B and neomycin

Whenever possible one agent should be used instead of the shot gun method of mixtures When infectious exudates are not avail

	URINE	CO_2 COMBINING POWER
METABOLIC ACIDOSIS (base bicarbonate deficit)	ACID	REDUCED
METABOLIC ALKALOSIS (base bicarbonate excess)	ALKALINE	INCREASED
RESPIRATORY ACIDOSIS (carbonic acid excess)	ACID	INCREASED
RESPIRATORY ALKALOSIS (carbonic acid deficit)	ALKALINE	REDUCED

FIG 40 The urinary findings and the carbon dioxide combining power in each of the four conditions

or salicylate intoxication Respirators may produce a state of hyper ventilation In these cases the breathing becomes hyperactive, and the lungs blow off an excess of carbon dioxide (carbonic acid) This results in a diminution of carbonic acid in the extracellular fluid and the pH rises to above 7 45 (alkalemia) The lungs cannot take part in any compensatory action, since they are directly associ ated with the etiology The kidneys become the main compensatory organs and as such attempt to retain hydrogen ions and excrete excessive amounts of bicarbonate ions The urine becomes alkaline As a result of the excessive renal output of bicarbonate ions the base bicarbonate diminishes and the carbon dioxide combining power is decreased This should not be confused with the increased CO combining power in *metabolic alkalosis (see p 50)*

The *treatment* of carbonic acid deficit is primarily directed to the removal of the cause and if parenteral fluids are indicated chloride ion containing solutions should be included to replace the bicarbonate ions In this instance 'physiologic sodium chloride solutions and Ringer s solution may prove to be beneficial

Figure 40 tabulates the urinary findings and the carbon dioxide combining power in each of the 4 conditions mentioned

this Usually, aqueous penicillin G plus one of the broad spectrum groups are selected

There are other bacterial infections which are too numerous to mention in a book of this type The reader has access to many informative monographs on the subject Some antimicrobials depopulate the bowel, such drugs as sulfasuxadine and sulfathaladine have been particularly useful in colon surgery Sulfasuxadine is preferred when constipation or obstipation is present, because it has a tendency to liquify the stool Sulfathaladine on the other hand, is useful when a diarrhea is present, since it has a tendency to solidify the stool All of these drugs may be dangerous if used over a long period of time since the intestinal flora live symbiotically with intestinal yeasts This normal equilibrium is important to maintain If the bacterial yeast balance is disturbed or destroyed the yeasts may predominate, and a monilial infestation results This can result in either severe morbidity or mortality The attending physician should be alerted to the complaint of pruritis ani in any patient who is on antimicrobial therapy This symptom usually signifies a yeast infestation, the therapy should be stopped at once Some pharmaceutical houses have added a yeast inhibitor to the anti microbial agents Intestinal bacteria are necessary for the synthesis of vitamin K When antimicrobials are used it is wise to administer vitamin K, thereby avoiding a possible deficiency which could result in hemorrhages, many of which are subclinical and unnoticed

able for study, the selection of the proper chemotherapeutic agent must be determined by a presumptive diagnosis Sensitivity tests can be read within 18 to 48 hours These methods utilize disks which are impregnated with various antibiotics The method is sufficiently accurate and simple to be employed extensively The majority of the antimicrobials exert a bacteriostatic effect, however, in some of them (penicillin) the usage of large doses may become bacteriocidal Toxicity and allergic responses must always be kept in mind

Staphylococcal infections occur as *aureus, albus* or *citreus* depending upon the color They have a tendency to remain localized and form abscesses which exude a thick, creamy, odorless pus However, some strains may be extremely virulent and produce fatal septicemia and pyemia Currently, the antibiotic *treatment* of choice is aqueous penicillin G, and procaine penicillin is preferred by some Likewise effective is erythromycin, 100 to 200 mg every 6 hours given orally *The broader spectrum antibiotics can be used* if a penicillin resistant organism is present Drugs of second choice are the cyclin group in doses of 250 to 500 mg every 4 to 6 hours If it becomes necessary to use bacitracin, daily urinalysis should be done to detect signs of nephrotoxicity

The most frequent offender in the *streptococcal infections* is the *Streptococcus hemolyticus however* the other members namely *Streptococcus anhemolyticus viridans anaerobius* and microaerophilic streptococcus are also omnipresent The hemolyticus infections are characterized by diffuse inflammation with cellulitis lymphangitis lymphadenitis and extension along fascial planes There is little tendency to localization and abscess formation but rather to the formation of a thin watery pus associated with gangrene of the overlying skin Bacteremia should be suspected with the appearance of chills hyperpyrexia and prostration The current *treatment* is similar to that described under staphylococcal infections the agent of choice being penicillin

In *mixed infections* it is advisable to use *two* antimicrobial agents Although there is some experimental evidence that antagonism may be present in such usage clinical experience does not substantiate

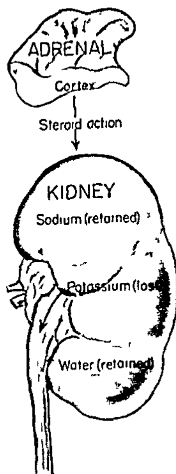


FIG 42 During the first 24 postoperative hours cortical steroid action in the kidney enhances sodium and water retention and potassium excretion

gland via the blood stream and stimulates the *cortex* of the gland which responds with an outpouring of numerous steroids Much remains unsolved regarding these steroids as to number and effects, however the effects of a particular steroid on water and electrolyte balance have been studied extensively This steroid affects the kid ney function in such a way that sodium and water are retained, and potassium is excreted (Fig 42) Therefore it is preferable to with hold some water and sodium for the first 24 hours postoperatively and to supply and replenish the potassium loss It has been the author s practice to supply in the first 24 hours 1,000 cc of water in a 5 per cent dextrose solution to which 3 Gm of potassium chloride have been added No sodium chloride is given during this first postoperative day unless there is a specific indication or depletion

7

ACTH

Selye has emphasized the importance of a stress or alarm action to such things as psychic trauma anesthesia, exposure, surgical manipulation, etc A possible explanation for this response is illus trated in Figure 41 The *medulla* of the adrenal gland, when stimu lated by stress of trauma produces epinephrine This reaches the blood stream and is carried to the anterior lobe of the pituitary gland, which responds with a production of an *adrenocortico tropic hormone* (ACTH) This hormone is returned to the adrenal

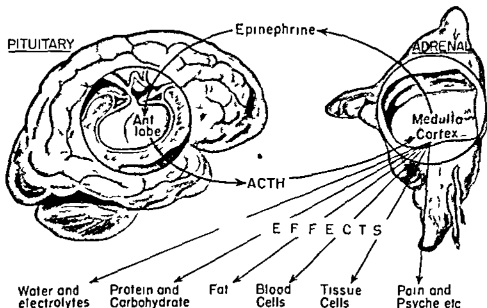


FIG 41 The theoretical explanation of the mechanism of ACTH production and some of its effects

LOW GRADE FEVER

Low grade fever is usually present and is expected for the first 3 postoperative days It is the rule rather than the exception for such patients to have a fever of 99 or 100 This is supposedly due to trauma, low grade infection and tissue and protein absorption If fever continues beyond the third day, a careful search must be made for the cause Although there are numerous causes of post operative fevers one of the following 4 conditions will be discovered in most cases (Fig 43)

1 Wound infections
2 Cystopyelitis
3 Phlebothrombosis (thrombophlebitis)
4 Pulmonary complications



Fig 44 Flat roentgenogram of chest revealing the unaerated patch of postoperative atelectasis A right subphrenic postoperative pneumoperitoneum is visible also

8

Postoperative Fever

The author has found it helpful to differentiate two types of postoperative fever (1) low grade fever (up to 100°) and (2) *hyperpyrexia (103° or over)*

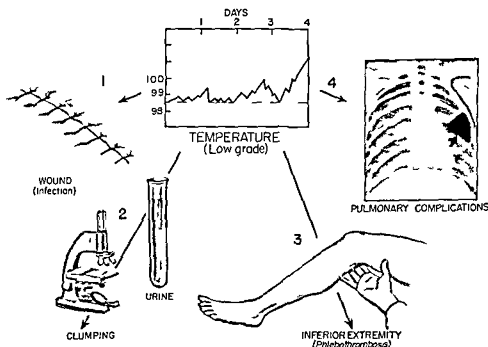


FIG 43 Postoperative complications Fever continuing beyond the third postoperative day suggests 1 of 4 complications wound infection cystopyelitis pulmonary complications or phlebothrombosis (thrombophlebitis)

2 A catheterized urine specimen will reveal microscopic clumping if a urinary infection is present This can be treated with one of the urinary antiseptics and possibly by changing the pH of the urine

3 A flat roentgenogram of the chest (portable if necessary) may reveal an atelectasis and/or pneumonitis (Fig 44) Atelectasis can be prevented by tracheobronchial toilette All postoperative patients are instructed to breath deeply and cough If fear or pain prevent him from coughing we assist him by passing a soft rubber catheter and instituting intratracheal suction If an atelectatic patch has developed trained personnel should consider this an emergency and proceed with the following therapy pass a simple rubber catheter down the nose into the trachea, turn the patient s head to the uninvolved side and let the catheter slip into the opposite bronchus (involved side) (Fig 45) Then suction can be applied

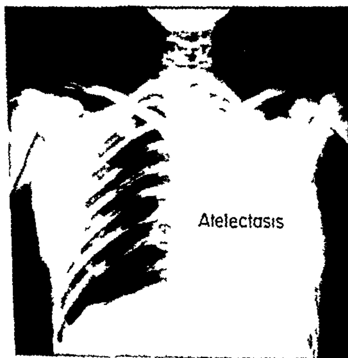


Fig 46 Flat roentgenogram of massive atelectasis (postoperative) of the lung

1 The vast majority of postoperative fevers are due to wound infections It is unnecesary to remove the dressing every day, but if a fever persists, the wound should be inspected Two things should be sought for a reaction around a given stitch or a group of stitches and/or a wet dressing It is confusing if one uses colored solutions in preparing the skin since this hides the telltale redness (hyperemia) and the local reaction around the infected sutures When an infection is present the involved stitch or stitches in the infected area should be removed It is unnecessary to remove all of the sutures unless the entire wound is involved Then the usual local and antimicrobial treatment is instituted

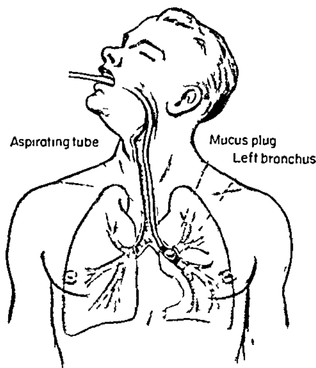


FIG 45 A simple technic for tracheobronchial aspiration Note that the patient s head is turned away from the side of pathology thus permitting the cather to slip into the bronchus of the involved side

9

Bowel Distention

This is a most distressing complication because of the discomfort that it produces and because of the possibilities of postoperative herniation and evisceration To treat it properly one must determine whether the distention involves the large bowel the small bowel or both The clinical differentiation is not too difficult to make



Fig 48 The typical stepladder or paralleling pattern seen in small bowel obstruction

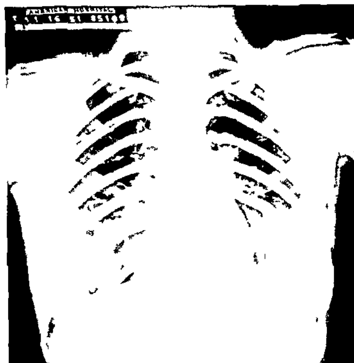


FIG 47 Roentgenogram of the same patient as seen in Figure 46 following endobronchial aspiration Such dramatic results are obtained immediately if proper therapy is instituted

If this does not prove to be immediately and dramatically beneficial massive atelectasis must be considered, and the help of a bronchologist or a trained anesthetist must be obtained

4 The popliteal spaces should be examined for tenderness since this may be present in phlebothrombosis This is discussed more thoroughly on page 80

HYPERPYREXIA

Hyperpyrexia is excessive fever (over 103°) If it occurs *within* the first 48 hours postoperatively, it is almost pathognomonic of massive atelectasis These patients appear to be very ill, they are cyanotic and have an increased respiratory rate and dyspnea An emergency flat roentgenogram should reveal the atelectatic lung (Fig 46) These patients die rapidly if the offending mucus plug is not removed they will not respond to oxygen and chemotherapy If the offending mucus plus is removed by means of endotracheal suction the relief and cure are immediate (Fig 47)

it reveals the so called 'horseshoe pattern if the large bowel is distended (Fig 49) In those cases where both the large and the small bowel are distended the paralleling and the horseshoe patterns are seen simultaneously (Fig 50) It is unnecessary to demonstrate the presence of fluid levels since the gaseous bowel pattern is usually sufficient to reveal the clinical picture

The treatment depends upon the type of distention (Fig 51) If the case is one of *small bowel distention*, nasogastric siphonage becomes essential Whether one chooses to use the simple Levin tube or to utilize the longer tubes such as the Miller Abbott depends upon personal preference The author confesses that in some cases he still has difficulty in passing the longer tubes successfully He utilizes all the necessary prerequisites such as placing the patient on his right side antispasmotics carbonated liquids enemas and checking the progress of the tube under the fluoroscope, however



Fig 50 The typical roentgenographic appearance when distention is due to both small and large bowel involvement

Patients with large bowel distentions rarely vomit, whereas patients with small bowel obstructions vomit early and repeatedly With diffuse postoperative peritoneal soiling both the large and the small bowel become distended (paralytic ileus) When an incompetent ileocecal valve is present (25%) it is possible for the contents of an obstructed large bowel to overflow into the small bowel so that the picture of both large and small bowel distention appears The flat roentgenogram reveals a typical paralleling or stepladder pattern if the distention involves only the small bowel (Fig 48),



FIG 49 The horseshoe pattern seen in large bowel obstruction The transverse colon is barely visible but the distended ascending and descending cola are clearly visible

electrolytes and water, these must be replaced (see p 26) In cases of *large bowel distention* nasogastric siphonage is of little or no help It is in this type of case that low, warm, tap water or soap suds enemas are indicated

One of the outstanding causes of large bowel postoperative distention is fecal impaction this is particularly true in the aged (Fig 52) It is unfortunate but nevertheless true that rectal examinations are overlooked too frequently The aphorism "when you don t put your finger in it you put your foot in it" can be aptly applied to such cases If such impaction is present, it rarely will be relieved by

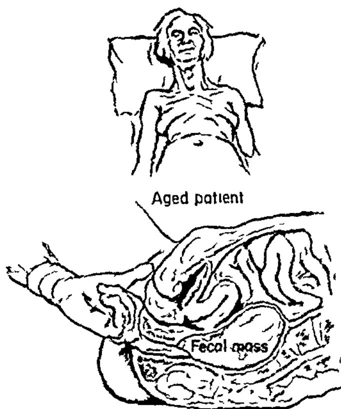


FIG 52 A frequently overlooked cause of large bowel distention is fecal impaction This is particularly true in the aged patient Routine rectal examinations will reveal the cause

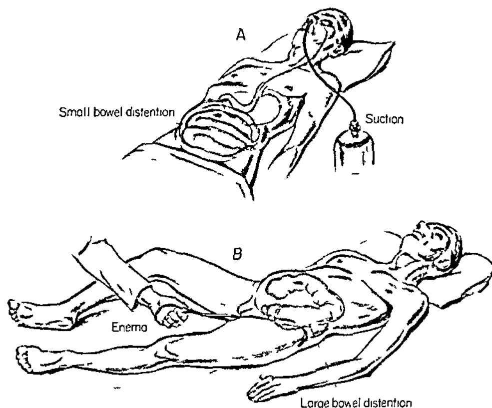


FIG 51 The treatment of postoperative distention (A) In small bowel distention nasogastric suction should be used (B) In large bowel distention (nonorganic obstruction), colon stimulants (if permissible) and enemas should be used

in the vast majority of instances the tube strikes the pylorus and returns One method which may expedite the passage of the longer tubes is to pass it into the stomach and then advance it an inch an hour In this way the tube has a better chance of getting past the pylorus In most instances sufficient relief can be obtained by placing the Levin tube in the stomach or the upper duodenum, since the contents from the lower recesses of the obstructed small bowel are present here and can be removed As soon as excess air and fluid are removed the distention disappears and bowel tonus returns Whenever suction is used the patient is being depleted of

10

Morphine

Postoperative pain must be relieved, however, one should endeavor to avoid morphine whenever possible (Fig 54) Since morphine is a smooth muscle contractor, it predisposes to broncho constriction, bronchial obstruction and atelectasis, it also diminishes the cough reflex and depresses the patient Many other valuable

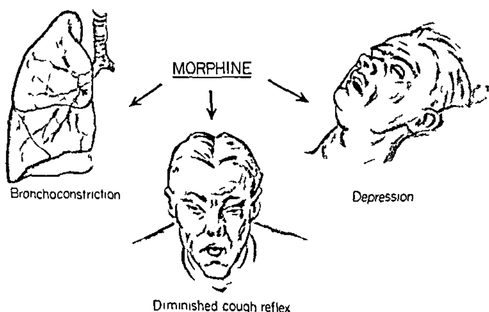


FIG 54 One should attempt to avoid the usage of morphine postoperatively it produces bronchoconstriction diminishes the cough reflex and depresses the patient

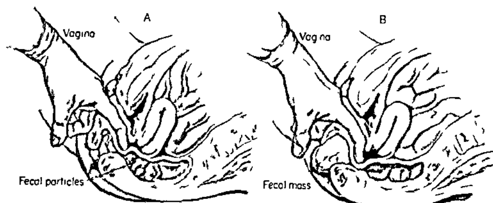


FIG 53 Fecal masses may be removed or broken digitally by placing the finger in the vagina

enemas alone Such impactions must be broken by means of oil retention or peroxide enemas and manual manipulation of the fecal mass, followed by cleansing enemas In females easier manipulation of the fecal mass can be done vaginally (Fig 53)

When both large and small bowel distention are present as a result of peritonitis the abdominal sounds are diminished or absent This can be determined by abdominal auscultation In such cases the definitive treatment is nasogastric siphonage, here the longer tubes are preferable Enemas will also be helpful in these cases

11

Urinary Retention

Patients may have considerable difficulty in voiding postoperatively In addition to dulling of the senses with narcosis and sedatives, there is a strong psychic factor which exists, since most people have been conditioned against voiding in bed Overdistention of the bladder might result The simplest and easiest method is to permit the patient to stand alongside of his bed and void into a urinal or permit him to sit on a portable commode This is almost always successful Frequent voiding of small amounts (100 cc) should suggest an overdistended bladder A retention catheter may be indicated If urinary tract infection is present, the urine should be examined and/or cultured and suitable therapy instituted Plus the usual antimicrobials mandelic acid Furadantin or Pyridium may be helpful

medicaments can be used in its place The use of some of the tranquilizers, barbiturates and substances such as Demerol are valuable substitutes Should these simpler measures fail and if the pain is so severe that the patient is unable to obtain rest then it becomes necessary to use morphine in as small a dose as possible

13

Postoperative Parotitis

Surgical mumps is seen infrequently but when present may be a most uncomfortable and devastating complication Although the etiology still remains obscure staphylococci have been cultured from the parotid ducts Early feeding as well as the use of antimicrobials may account for the less frequent occurrence of such parotitis Chewing gum, particularly in older patients, may be beneficial as a prophylactic measure, since it prevents stasis in the salivary ducts Severe dehydration and poor oral hygiene also predispose to its occurrence Massive doses of penicillin are almost a specific To this should be added potassium iodide and deep roentgen therapy The latter usually dissipates the residual induration that frequently follows the acute attack

12

Nausea and Vomiting

Morphine (opiates) predisposes to both nausea and vomiting since morphine does not rest but rather increases gastric motor activity Dry foods rather than liquid diets are preferable Nothing by mouth may be necessary for some hours Fifty or 100 mg of intramuscular Dramamine or 50 mg of Thorazine may prove very helpful It may become necesary to resort to nasogastric suction

13

Postoperative Parotitis

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14

Hiccup

This complication (postoperative singultus) is not only unpleasant but can become exhausting and dangerous The clinician must rule out such causes as gastric distention, diaphragmatic irritation and impending uremia The number of therapeutic measures advocated is legion Intramuscular injection of 25 to 50 mg of Thorazine every 4 to 6 hours has been helpful In extreme cases which threaten life the crushing or one or both phrenic nerves becomes necessary

15

Early Ambulation

Early ambulation was practiced many decades ago and now has been rediscovered One cannot standardize its application so that every patient is out of bed on the first postoperative day However, we should attempt to ambulate our patients as early as possible The type of individual, the nature of the operation, the general condition of the patient must be evaluated in determining when to get him out of bed We make every effort to have him take a few steps on the first postoperative day by the second day he is usually walking around the room and the hall Such ambulation should minimize postoperative phlebothrombosis, thrombophebitis and pulmonary embolus, also, it does much to promote a healthy attitude, diminishes intestinal distress and restores body tones The incidence of evisceration and postoperative hernia is apparently not increased

16

Phlebothrombosis and Thrombophlebitis

It is the opinion of some that these two conditions are related in that phlebothrombosis is the early phase and thrombophlebitis a later phase *Phlebothrombosis* is the dangerous phase, because it

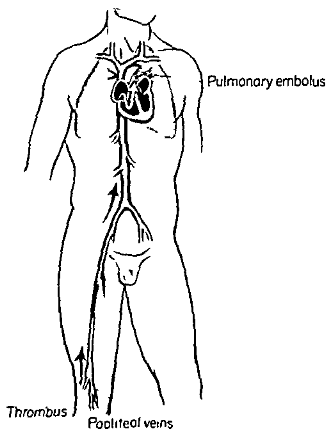


FIG 55 Phlebothrombosis A thrombus in the popliteal veins or the pelvic veins may break away and produce pulmonary emboli

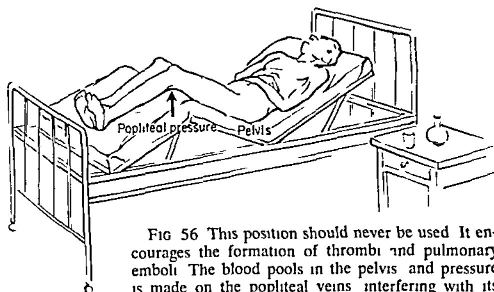


Fig 56 This position should never be used It encourages the formation of thrombi and pulmonary emboli The blood pools in the pelvis and pressure is made on the popliteal veins interfering with its return flow

is in this 'silent stage that the thrombus is loosely attached to the vessel wall may break away and produce a fatal pulmonary embolus (Fig 55) The signs and symptoms of phlebothrombosis are difficult to detect clinically Low grade, postoperative fever is an important finding this has been alluded to on page 62 Homan's sign (pain in the calf on forcible dorsiflexion of the foot) may be present Tenderness may be elicited with pressure on the calves the popliteal space or the thigh Predisposing causes to the formation of thrombi are prolonged bed rest and certain dangerous positions that the patient maintains in bed (Fig 56) The most dangerous position is one in which the pelvis becomes the lowest point of gravity and the popliteal spaces are pressed upon by means of the knee rest This position produces a stagnation of venous blood and hinders its return flow

Unfortunately there is still room for progress in the prevention and the treatment of thrombo embolic disease Virchow first described it in 1866 Despite the usage of anticoagulants venous ligation and early ambulation the condition is still present It has been suggested that keeping the patient on the operating table for longer periods of time in this era of slow operating and extended

surgical procedures might play a part in encouraging stagnation of blood and thrombus formation

Thrombophlebitis is assumed to be the later stage of phlebothrombosis and is easier to recognize clinically Older textbooks refer to it as phlegmasia alba dolens (milk leg) It is detected easily because of the pain, the swelling and the edema of the involved extremity In this stage the thrombus is believed to be firmly fixed to the intima of the vessel and therefore rarely produces pulmonary emboli Possibly the two best methods at our disposal in managing this condition are the use of enzyme treatment (Chymar) and repeated sympathetic blocks

17

Evisceration

This complication (Fig 57) is known to every seasoned surgeon Although frightening it is rarely fatal if corrected promptly and properly There can be no doubt that an inadequate closure of the abdominal wall is one of the most common causes of evisceration, however, it must be emphasized that the debilitated patient who does not have the ability to heal can eviscerate regardless of the type of closure

Nonabsorbable retention sutures should be used in all patients

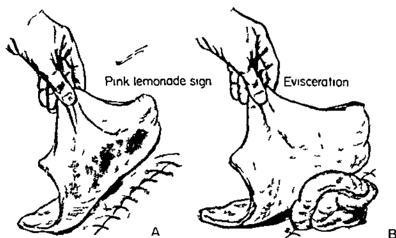


Fig 57 (A) The presence of watery pink fluid on the dressing is called the pink lemonade sign It foretells an impending evisceration (B) Evisceration is usually a frightening sight however if treated promptly and adequately the results are excellent

who have suffered from a chronic gastro intestinal complaint this is particularly true of patients with carcinoma who are in negative nutritional balance If sutures are removed too soon, evisceration or postoperative hernia may result (see Suture Removing, p 86) The preoperative presence of anemia hypoproteinemia and vitamin deficiencies must be corrected If the wound closure has been per formed carefully, and if the patient s ability to heal his wound is adequate then early ambulation will not predispose to evisceration

One can foretell an impending evisceration if one is aware of what the author prefers to call the *pink lemonade sign* The dress ing should be inspected daily The presence of a watery pink fluid

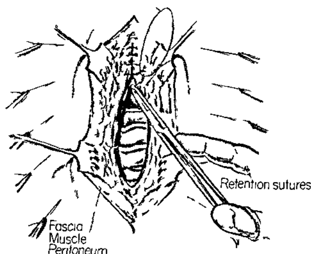


FIG 58 The surgical repair of a disrupted wound Heavy nonabsorbable suture material is used Each bite includes all layers of the abdominal wall (skin fascia muscle and peritoneum) These through and through su tures are not tied until a running catgut suture is placed in the fascia (see text) The running catgut stitch is not placed if the patient s condition is poor

almost always suggests impending evisceration This is not to be confused with a seropurulent or frank hemorrhagic discharge from the wound The "pink lemonade sign is, as its name suggests, a watery pink solution

If the sign is present, these patients are not ambulated, the wound is strapped firmly, and a firm abdominal binder is applied In this way many eviscerations can be avoided Most of these patients develop a postoperative hernia ACTH and similar substances predispose to evisceration Although these substances increase the healing ability of ectodermal structures they interfere with healing of derivatives of mesoderm such as muscle and fascia Postoperative pulmonary complications (coughing distention and vomiting) also predispose to wound disruption

An evisceration should be corrected surgically as soon as the diagnosis is made There are some who advocate pulling the edges of the wound together firmly by means of adhesive bridges and binders this is rarely indicated Adequate closure is accomplished best by passing large nonabsorbable sutures (crochet cotton No 10) through the skin the fascia the muscle and the peritoneum of both sides (Fig 58) These sutures are not tied until a continuous catgut suture is placed It must be recalled that these wounds will not reveal separate layers as were noted at the first operation because the peritoneum the muscle and the fascia are usually fused into one homogenous mass Therefore the running catgut suture includes all layers (particularly fascia) Following the placement of this suture, the retention sutures are tied It is comforting to know that patients who eviscerate have attained a high degree of resistance to peritonitis and most of them recover

18

Removal of Sutures

It is dangerous to adhere to a strict routine of suture removal on a given day The author never has subscribed to the idea that sutures in an appendectomy or herniorrhaphy wound should be removed on the seventh day or in a gastric or a gallbladder operation on the tenth day No two people heal in exactly the same way It is much safer to remove every second or third stitch after a week or 10 days If healing seems to be progressing favorably and no wound separation appears the remaining sutures can be removed 3 to 5 days later

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Shock

If shock is present its treatment takes precedence over all other therapy with the exception of visible external hemorrhage The 6 outstanding signs of shock are recognized easily (Fig 59)

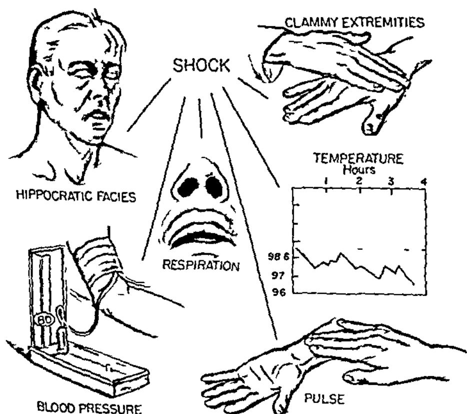


Fig 59 The 6 signs of shock

1 The *Hippocratic facies* is grayish, haggard, drawn and life less The word grayish is most descriptive, since people in shock do not have a whitish pallor but rather a sickening gray hue The pale white pallor is suggestive of hemorrhage, possibly associated with shock but not of shock per se

2 *Cold clammy extremities* It is simple to feel the hands and the feet of the patient to determine whether or not this is present

3 The *temperature* is usually subnormal The exception is the severely burned patient who has a fever or at times hyperpyrexia while in a state of shock

4 The *pulse* is characteristic in that it is rapid feeble and thready Thready is a most descriptive word and suggests the "thin feel of the pulse which is easily compressible

5 *Respirations* are increased since the patients in shock suffer from hypoxia To compensate for this they breathe more rapidly However the respirations are usually regular

6 The *blood pressure* is characteristic Patients in shock have a definite hypotension, the degree may vary It is safe to say that in most instances the patient in shock has a systolic pressure below 80

When shock is present it must be treated before any consideration is given to any other preoperative management The mnemonic that the author uses in the *treatment* of shock is the word BOMBS

*B*ody heat
*O*xygen
*M*edications
*B*lood and its derivatives
*S*urgery

Body heat must be maintained it is surprising how frequently this simple yet most efficacious method of combating shock is overlooked *The best way to maintain body heat is to strip the patient* of his cold wet clothing and wrap him in warm blankets (Fig 60) Not only his ventral surface but also his dorsal surface must be covered Under no circumstances should hot water bottles be applied to the shocked patient Their cutaneous resistance to external heat is low and they are likely to develop severe burns

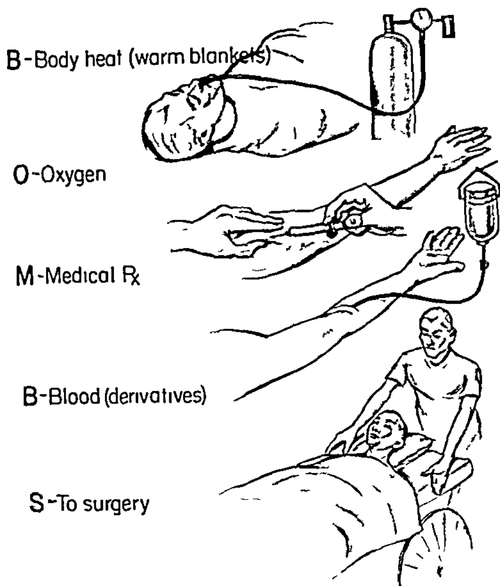


FIG 60 The treatment of shock The patient should be wrapped in warm blankets Oxygen is administered and the patient is placed in the shock position (head down)

Many a malpractice suit could have been avoided if the patient in shock had not had hot water bottles applied (see p 25)

Oxygen must be supplied, since these patients suffer from hypoxia This can be administered either by means of an oxygen room, an oxygen tent or, as is most practical in the emergency room a nasal catheter *Shocked patients die from the want of oxygen to the* medulla oblongata (cardiorespiratory centers) The blood supply to these centers can be increased by placing the patient in the *shock position* this is a modified Trendelenburg position (Fig 60) It is accomplished by using shock blocks which are blocks of wood approximately 1 foot tall placed under the foot of the bed If such shock blocks are not available placement of a chair under the foot end of the bed will suffice

Numerous *medications* have been advocated One must be particularly cautious in the usage of morphine, since it depresses the respirations If pain is not present morphine or any other depressant is contraindicated If pain is present it can be relieved by a small dose of a sedative

Blood and its derivatives have a place in the treatment of shock Blood may be the fluid of choice and is often lifesaving but it is not without danger It has a depressing effect on the red bone marrow as well as the ever present dangers of incompatabilities and transmission of diseases If shock is present in conjunction with hemorrhage then blood must be supplied However, if nonhemorrhagic shock is present plasma becomes the fluid of choice It is necessary to supply only that liquid which has escaped from the capillary bed namely plasma When this is restored the red cells which have been corking the capillaries will recirculate and oxygen will be supplied to vital organs and centers of the body Plasma must be screened carefully since certain viral infections particularly viral hepatitis have been transmitted via this route Albumin has been advocated for shock therapy it restores and possibly maintains an effective blood volume It has been stated that 50 cc of 25 per cent albumin (human) given intravenously should pull 175 cc of fluid back into the circulating system in 15 minutes It would take 250 cc of plasma or 500 cc of whole blood to do the same At present numerous

blood expanders and certain pressure stabilizers, such as Levophed, are advocated Excellent monographs on these specific substances are available

Surgery should not be contemplated when shock is present Only after the state of shock has been corrected should one attempt to do definitive surgery If the patient in shock expires while under shock treatment, the physician cannot be condemned

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